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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



Box Patent Application  
Assistant Commissioner for Patents  
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventors: Stephen R. Genheimer, Kenneth L. Pottebaum, Jon P. Baker and John D. Stricklin

For (title): ACTUATOR ASSEMBLY MOUNTED DISC SNUBBER (As amended by  
Preliminary Amendment)

1. Type of Application

This transmittal is for a divisional application of U.S. Application 08/659,338 filed June 6, 1996 and now pending which claims the benefit of provisional application 60/004,924 filed October 6, 1995.

2. Benefit of Prior U.S. Application(s) (35 U.S.C. 119(e), 120, 121)

- ☒ This divisional application claims the benefit of prior U.S. Application(s) and enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed

A. Required for filing date under 37 C.F.R. 1.53(b) (Regular) or 37 C.F.R. 1.153 (Design) Application

Enclosed are copies of the following from U.S. Serial No. 08/659,338:

- 18 Pages of specification
- 7 Pages of claims
- 1 Page of Abstract
- 5 Sheets of drawings (informal)
- 8 Pages Combined Declaration and Power of Attorney

**4. Additional Papers Enclosed**

- ☒ Preliminary Amendment
- ☒ Acknowledgment Postcard
- ☒ Copy of the NOTIFICATION OF FILING OF CONTINUING, DIVISIONAL OR CONTINUED PROSECUTION APPLICATION filed in U.S. Serial No. 08/659,338

**5. Declaration or Oath**

Enclosed (See copy listed above as filed in Serial No. 08/659,338)

**6. Inventorship Statement**

The inventorship for all the claims in this application is the same.

**7. Language**

English

**8. Assignment**

A copy of the assignment of the invention to Seagate Technology, Inc. is attached as filed in Serial No. 08/659,338.

- 9.** It is respectfully requested that claims 2-17 be canceled. A Preliminary Amendment is enclosed canceling claim 1 and adding new claims 18-24.

**10. Fee Calculation (37 C.F.R. 1.16)**

Regular Application

CLAIMS AS AMENDED BY PRELIMINARY AMENDMENT					
Claims	Number Filed	Basic Fee Allowance	Number Extra	Rate	Basic Fee 37 CFR 1.16(a) \$790.00
Total Claims (37 CFR 1.16(c))	7	- 20 =	0 x	\$0.00	\$0.00
Independent Claims (37 CFR 1.16(b))	3	- 3 =	0 x	\$0.00	\$0.00
Multiple Dependent Claim(s), if any (37 CFR 1.16(d))			+	\$0.00	

Filing Fee Calculation

\$790.00

**11. Fee Payment Being Made at This Time**

Enclosed

Filing Fee for claims as amended

\$790.00

**Total Fees Enclosed**

**\$790.00**

**12. Method of Payment of Fees**

Check in the amount of \$790.00 is attached.

**13. Authorization to Charge Additional Fees**

The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 13-0110.

- ☒ 37 C.F.R. 1.16(a), (f) or (g) (filing fees)
- ☒ 37 C.F.R. 1.16(b), (c) or (d) presentation of extra claims



Inventor(s): Stephen R. Genheimer, Kenneth L. Pottebaum, Jon P. Baker and  
John D. Stricklin

For: ACTUATOR ASSEMBLY MOUNTED DISC SNUBBER (As Amended by  
Preliminary Amendment)

**ADDED PAGES FOR APPLICATION TRANSMITTAL WHERE  
BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED**

NOTE: See 37 CFR 1.78(a)

**17. Relate Back**

**Warning:** *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the application should consider cancelling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

*(complete the following, if applicable)*

☒ Amend the specification by inserting, before the first line, the following sentence:

**A. 35 U.S.C. 119(e)**

NOTE: "Any nonprovisional application claiming the benefit of one or more prior filed copending provisional applications must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior provisional application, identifying it as a provisional application, and including the provisional application number (consisting of series code and serial number)." 37 CFR § 1.78(a)(4).

☐ "This application claims the benefit of U.S. Provisional Application(s)  
No(s).:

**APPLICATION NO(S).:**

**FILING DATE**

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**B. 35 U.S.C. 120, 121 AND 365(c)**

*NOTE: "Any nonprovisional application claiming the benefit of one or more prior filed copending nonprovisional applications or international applications designating the United States of America must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior application, identifying it by application number (consisting of the series code and serial number) or international application number and international filing date and indicating the relationship of the applications. Cross-references to other related applications may be made when appropriate. (See § 1.14(b))." 37 CFR § 1.78(2).*

- ☒ "This application is a
- ☐ continuation
  - ☐ continuation-in-part
  - ☒ divisional

of copending application(s)

- ☒ application number 08/659,338 filed on June 6, 1996.
- ☐ International Application \_\_\_\_\_ filed on \_\_\_\_\_ and which designated the U.S."

*NOTE: The proper reference to a prior filed PCT application that entered the U.S. national phase is the U.S. serial number and the filing date of the PCT application that designated the U.S.*

*NOTE: (1) Where the application being transmitted adds subject matter to the International Application, then the filing can be as a continuation-in-part or (2) if it is desired to do so for other reasons then the filing can be as a continuation.*

- ☒ "The nonprovisional 08/659,338 application claimed the benefit of U.S. Provisional Application(s) No(s).:

**APPLICATION NO(S).:**

**FILING DATE**

60/004,924

October 6, 1995

*NOTE: The deadline for entering the national phase in the U.S. for an international application was clarified in the Notice of April 28, 1987 (1079 O.G. 32 to 46) as follows:*

*"The Patent and Trademark Office considers the International application to be pending until the 22nd month from the priority date if the United States has been designated and no Demand for International Preliminary Examination has been filed prior to the expiration of the 19th month from the priority date, provided that a copy of the international application has been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively.*

*If a copy of the international application has not been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively, the international application becomes abandoned as to the United States 20 or 30 months from the priority date respectively. These periods have been placed in the rules as paragraph (h) of § 1.494 and paragraph (i) of § 1.495. A continuing application under 35 U.S.C. 365(c) and 120 may be filed anytime during the pendency of the international application."*

## 18. Relate Back - 35 U.S.C. 119 Priority Claim for Prior Application

The prior U.S. application(s), including any prior International Application designating the U.S., identified above in item 17B, in turn itself claim(s) foreign priority(ies) as follows:

Country	Appln. no.	Filed on
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The certified copy(ies) has (have)

- ☐ been filed on \_\_\_\_\_, in prior application \_\_\_\_\_, which was filed on \_\_\_\_\_.
- ☐ is (are) attached.

### WARNING:

*The certified copy of the priority application that may have been communicated to the PTO by the International Bureau may not be relied on without any need to file a certified copy of the priority application in the continuing application. This is so because the certified copy of the priority application communicated by the International Bureau is placed in a folder and is not assigned a U.S. serial number unless the national stage is entered. Such folders are disposed of if the national stage is not entered. Therefore, such certified copies may not be available if needed later in the prosecution of a continuing application. An alternative would be to physically remove the priority documents from the folders and transfer them to the continuing application. The resources required to request transfer, retrieve the folders, make suitable record notations, transfer the certified copies, enter and make a record of such copies in the Continuing Application are substantial. Accordingly, the priority documents in folders of international applications that have not entered the national stage may not be relied on. Notice of April 28, 1987 (1079 O.G. 32 to 46).*

## 19. Maintenance of Copendency of Prior Application

**NOTE:** *The PTO finds it useful if a copy of the petition filed in the prior application extending the term for response is filed with the papers constituting the filing of the continuation application. Notice of November 5, 1985 (1060 O.G. 27).*

- A. ☐ Extension of time in prior application  
(This item **must** be completed and the papers filed in the prior application, if the period set in the prior application has run.)
- ☐ A petition, fee and response extends the term in the pending prior application until \_\_\_\_\_.

☐ A copy of the petition filed in prior application is attached.

B. ☐ Conditional Petition for Extension of Time in Prior Application  
(complete this item, if previous item not applicable)

☐ A conditional petition for extension of time is being filed in the pending **prior** application.

☐ A **copy** of the conditional petition filed in the prior application is attached.

## 20. Further Inventorship Statement Where Benefit of Prior Application(s) Claimed

NOTE: "If the continuation, continuation-in-part, or divisional application is filed by less than all the inventors named in the prior application a statement **must** accompany the application when filed requesting deletion of the names of the person or persons who are not inventors of the invention being claimed in the continuation, continuation-in-part, or divisional application." 37 CFR 1.62(a) [emphasis added]. (dealing with the file wrapper continuation situation).

NOTE: "In the case of a continuation-in-part application which adds and claims additional disclosure by amendment, an oath or declaration as required by § 1.63 must be filed. In those situations where a new oath or declaration is required due to additional subject matter being claimed, additional inventors may be named in the continuing application. In a continuation or divisional application which discloses and claims only subject matter disclosed in a prior application, no additional oath or declaration is required and the application must name as inventors the same or less than all the inventors in the prior application." 37 CFR 1.60(c) (dealing with the continuation situation).

(Complete applicable item (a), (b) and/or (c) below)

(a) ☐ This application discloses and claims only subject matter disclosed in the prior application whose particulars are set out above and the inventor(s) in this application are

☐ the same.

☐ less than those named in the prior application. It is requested that the following inventor(s) identified for the prior application be deleted:

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(type name(s) of inventor(s) to be deleted)

(b) ☐ This application discloses and claims additional disclosure by amendment and a new declaration or oath is being filed. With respect to the prior application, the inventors in this application are

☐ the same.

☐ the following additional inventor(s) have been added:

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(type name(s) of inventor(s) to be added)



- (c) ☒ The inventorship for all the claims in this application are
- ☒ the same.
- ☐ not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made
- ☐ is submitted.
- ☐ will be submitted.

**21. Abandonment of Prior Application (if applicable)**

- ☐ Please abandon the prior application at a time while the prior application is pending, or when the petition for extension of time or to revive in that application is granted, and when this application is granted a filing date, so as to make this application copending with said prior application.

*NOTE: According to the Notice of May 13, 1983 (103, TMOG 6-7), the filing of a continuation or continuation-in-part application is a proper response with respect to a petition for extension of time or a petition to revive and should include the express abandonment of the prior application conditioned upon the granting of the petition and the granting of a filing date to the continuing application.*

**22. Petition for Suspension of Prosecution for the Time Necessary to File an Amendment**

**WARNING:** *"The claims of a new application may be finally rejected in the first Office action in those situations where (1) the new application is a continuing application of, or a substitute for, an earlier application, and (2) all the claims of the new application (a) are drawn to the same invention claimed in the earlier application, and (b) would have been properly finally rejected on the grounds of art of record in the next Office action if they had been entered in the earlier application." MPEP, § 706.07(b).*

*NOTE: Where it is possible that the claims on file will give rise to a first action final for this continuation application and for some reason an amendment cannot be filed promptly (e.g., experimental data is being gathered) it may be desirable to file a petition for suspension of prosecution for the time necessary.*

*(check the next item, if applicable)*

- ☐ There is provided herewith a Petition to Suspend Prosecution for the Time Necessary to File An Amendment (New Application Filed Concurrently)

**23. Small Entity (37 CFR 1.28(a))**

- ☐ Applicant has established small entity status by the filing of a verified statement in parent application \_\_\_\_\_ on \_\_\_\_\_ .
- ☐ A copy of the verified statement previously filed is included.

**WARNING:** See 37 CFR § 1.28(a)

**24. NOTIFICATION IN PARENT APPLICATION OF THIS FILING**

- ☒ A notification of the filing of this *(check one of the following)*
- ☐ continuation
- ☐ continuation-in-part
- ☒ divisional

is being filed in the parent application, from which this application claims priority under 35 U.S.C. § 120.

PATENT APPLICATION  
DOCKET NO. 21843

A P P L I C A T I O N

O F

STEPHEN R. GENHEIMER  
KENNETH L. POTTEBAUM  
JON P. BAKER  
JOHN D. STRICKLIN

F O R

U N I T E D S T A T E S L E T T E R S P A T E N T

O N

M E C H A N I C A L S H O C K P R O T E C T I O N F O R A D I S C D R I V E

Docket No. 21843  
Sheets of Drawings: 5

McCarthy & Associates, Inc.  
101 Park Avenue - Suite 250  
Oklahoma City, Oklahoma 73102  
Telephone: (405)232-5600

DOCKET NO. 21843

## MECHANICAL SHOCK PROTECTION FOR A DISC DRIVE

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### Cross Reference to Related Applications

This application claims priority to Provisional Application Serial No. 60/004,924 filed October 6, 1995, and Provisional Application Serial No. 60/009,172 filed December 22, 1995, which are also hereby incorporated by reference.

### 5                   Background of the Invention

#### 1.     Field of the Invention

This invention relates generally to the field of disc drive data storage devices, and more particularly, but not by way of limitation, to a snubber for protecting a hard disc drive from damage due to non-operational, mechanical shocks.

#### 10    2.     Discussion

Disc drives are commonly used in workstations, personal computers, portables, and other computer systems to store large amounts of data in a form that can be made readily available to a user. In general, a disc drive comprises one or more magnetic discs that are rotated by a spindle motor at a constant high speed. The surface of  
15 each disc is divided into a series of data tracks which are spaced radially from one another across a band having an inner diameter and an outer diameter. The data tracks extends generally circumferentially around the discs and store data in the form of magnetic flux transitions within the radial extent of the tracks on the disc surfaces.

Typically, each data track is divided into a number of data sectors that store fixed sized data blocks.

5 A head includes an interactive element such as a magnetic transducer which senses the magnetic transitions on a selected data track to read the data stored on the track, or to transmit an electrical signal that induces magnetic transitions on the selected data track to write data to the track. The head includes a read/write gap that positions the active elements of the head at a position suitable for interaction with the magnetic transitions on the data tracks of a disc as the disc rotates.

10 As is known in the art, each head is mounted to a rotary actuator arm and is selectively positionable by the actuator arm over a preselected data track of the disc to either read data from or write data to the preselected data track. The head includes a slider assembly having an air bearing surface that causes the head to fly over the data tracks of the disc surface due to fluid air currents caused by rotation of the disc.

15 Typically, several discs are stacked on top of each other and the surfaces of the stacked discs are accessed by the heads mounted on a complementary stack of actuator arms which comprise an actuator assembly, or "E-block". The E-block generally includes head wires which conduct electrical signals from the heads to a flex circuit, which in turn conducts the electrical signals to a flex circuit bracket mounted to a disc drive base deck. For a general discussion of E-block assembly techniques,  
20 see U.S. Patent No. 5,404,636 entitled METHOD OF ASSEMBLING A DISK DRIVE ACTUATOR, issued April 11, 1995 to Stefansky et al., assigned to the assignee of the present invention and incorporated herein by reference.

As will be recognized, a continuing trend in the industry is the reduction in size of modern disc drives. As a result, the discs in the disc stacks of modern disc drives are being brought closer together, providing narrower vertical gaps between adjacent discs. Although facilitating greater amounts of storage capacity, such narrow vertical spacing of the discs gives rise to a problem of increased sensitivity of the disc drives to non-operating, mechanical shocks; particularly, predominant failure modes in modern disc drives have been found to include damage to the surfaces of the discs and damage to the actuator arms as a result of mechanical shocks encountered during the shipping and handling of the drives.

Computer modeling of particular disc drives has revealed that one primary cause of interference between discs and actuator arms is the first mechanical bending mode of the discs, which has been found to cause over 50% of the motion between the arms and discs in selected disc drive designs. The bending mode is generally dependent upon the material, diameter and thickness of the discs, and these factors are not readily modified in a disc drive design.

Thus, there is a need for an improved approach to reducing the susceptibility of damage in disc drives as a result of non-operating, mechanical shocks.

### **Summary of the Invention**

The present invention provides an apparatus for protecting a disc drive from damage due to mechanical shocks encountered during shipment and handling.

The disc drive comprises a disc mounted for rotation at a constant speed about a vertical axis, the disc having an inner radius and an outer radius. A rotary actuator

is mounted adjacent the disc, the rotary actuator controllably rotatable with respect to the disc. A snubber is provided adjacent the disc, the snubber having a body portion rigidly affixed to resist movement in the direction of the vertical axis of the disc. Additionally, snubber arms are connected to and extend from the body portion.

5       The snubber arms extend from the body portion towards the disc and above and below the elevation of the disc, with each snubber arm having a distal end located at a position adjacent the disc between the inner and outer radii of the disc and towards the outer radius of the disc. The vertical height of each snubber arm limits vertical deflection of the disc at the outer radius of the disc as a result of mechanical  
10    shock forces supplied to the disc drive assembly.

      An object of the present invention is to protect components of a disc drive, including discs and actuator assemblies, from damage due to non-operating, mechanical shocks encountered during shipping and handling of the drive.

      Another object of the present invention is to limit the deflection of the disc of a  
15   disc drive as a result of a mechanical shock.

      Still another object of the present invention is to provide protection from damage due to mechanical shocks in an easily implemented, cost effective manner.

      Other objects, advantages and features of the present invention will be apparent from the following description when read in conjunction with the drawings and  
20   appended claims.

### Brief Description of the Drawings

FIG. 1 is a top plan view of a disc drive in which the present invention is particularly useful.

FIG. 2 is a cross-sectional, elevational view of the cylindrical-shaped snubber  
5 of FIG. 1.

FIG. 3 is a cross-sectional, elevational view of an L-shaped snubber.

FIG. 4 is a top plan view of a disc drive having a shroud-mounted snubber.

FIG. 5 is a cross-sectional, elevational view of the shroud-mounted snubber of  
FIG. 4.

FIG. 6 is an elevational view of a snubber mounted to an E-block.  
10

FIG. 7 is a top plan view of the E-block and snubber of FIG. 6.

FIG. 8 is an elevational view of an E-block having an over-molded snubber.

FIG. 9 is a top plan view of the E-block and snubber of FIG. 8.

FIG. 10 is a cross-sectional, elevational view of a portion of an E-block and an  
15 associated pin snubber.

FIG. 11 is a top plan view of the E-block and pin snubber of FIG. 10.

FIG. 12 is an elevational view of a portion of an E-block with a flex circuit  
assembly having flex extensions which serve as a disc snubber.

FIG. 13 is an elevational view of a portion of an E-block with a flex circuit  
20 assembly having flex strips adjacent actuator arms and tabs which serve as a disc  
snubber.



### Detailed Description of the Preferred Embodiment

Turning now to the drawings and more particularly to FIG. 1, shown therein is a top plan view of a disc drive 10 in which the present invention is particularly useful. The disc drive 10 includes a base deck 12 to which various disc drive components are mounted and a top cover 14, which provides a sealed internal environment for the disc drive 10. The top cover 14 is shown in a partial cut-away fashion to expose selected components of interest.

Mounted to the base deck 12 is a spindle motor (shown generally at 16) to which a plurality of discs 18 are mounted for rotation at a constant high speed.

Adjacent the discs 18 is an actuator assembly 20 (hereinafter sometimes also referred to as an "E-block") which pivots about a pivot shaft 22 in a rotary fashion. The E-block 20 includes actuator arms 24 which support gimbal assemblies 26 (hereinafter also sometimes referred to as "load springs"). The load springs 26 in turn support heads 28, with each of the heads 28 corresponding to a surface of one of the discs 18.

As provided hereinabove, the heads 28 are positionably located over data tracks (not shown) of the discs 18 in order to read data from and write data to the tracks, respectively. At such time that the disc drive 10 is not in use, the heads 28 are moved to landing zones (denoted at broken line 30), which are located in FIG. 1 near the inner diameter of the discs 18.

It will be recognized that the E-block 20 is provided with a latching arrangement (shown generally at 32) to secure the E-block 20 when the disc drive 10 is not in use. For a general discussion of typical E-block latching arrangements, see

U.S. Patent No. 5,231,556 entitled SELF-HOLDING LATCH ASSEMBLY, issued July 27, 1993 to Blanks, assigned to the assignee of the present invention and incorporated herein by reference.

Continuing with FIG. 1, the E-block 20 is controllably positioned by way of a voice coil motor (VCM, shown generally at 34), comprising an actuator coil 36 immersed in the magnetic field generated by a permanent magnet 38. It will be recognized that a magnetically permeable flux path (such as a steel plate) is mounted above the actuator coil 36 to complete the magnetic circuit of the VCM 34, but for purposes of illustration this flux path has not been shown in FIG. 1. When controlled DC current is passed through the actuator coil 36, an electromagnetic field is set up which interacts with the magnetic circuit of the VCM 34 to cause the actuator coil 36 to move relative to the permanent magnet 38 in accordance with the well-known Lorentz relationship. As the actuator coil 36 moves, the E-block 20 pivots about the pivot shaft 22, causing the heads 28 to move across the surfaces of the discs 18.

To provide the requisite electrical conduction paths between the heads 28 and disc drive read/write circuitry (not shown), head wires (not separately shown) are routed on the E-block 20 from the heads 28, along the gimbal assemblies 26 and the actuator arms 24, to a flex circuit assembly 40. The head wires are secured (by way of a suitable soldering process) to corresponding pads (not separately designated in FIG. 1) of a printed circuit board (PCB) 42 of the flex circuit assembly 40. In turn, the flex circuit assembly 42 is connected to a flex circuit bracket (shown generally at 44) in a conventional manner. Preferably, the head wires are conductive wires having

a relatively small diameter and are coated with a thin insulating layer (such as teflon).

For purposes of clarity, this thin insulating layer is not separately designated in the drawings; however, it will be recognized that this insulating layer is not present at the ends of the head wires where the head wires are soldered to the pads of the PCB 42.

- 5 It will further be recognized that the actuator arms 24 and the gimbal assemblies 26 are provided with suitable wire guides (not separately shown) to capture and retain the head wires.

Additionally, FIG. 1 shows a snubber 100, which comprises a cylindrically-shaped assembly adjacent the stack of discs 18. As will be discussed in more detail  
10 below, the snubber 100 protects the disc drive 10 from damage as a result of mechanical shocks provided to the disc drive 10 without otherwise interfering with the normal operation of the drive. Particularly, the snubber 100 is provided with a configuration such that, when significant deflection of the discs 18 is induced by a mechanical shock incident, the discs 18 will contact the snubber 100 instead of the E-  
15 block 20, thus minimizing damage to the E-block 20 and the discs 18.

Referring now to FIG. 2, shown therein is a cross-sectional, elevational view of the snubber 100, in conjunction with outlying portions of the discs 18 and the base deck 12 of FIG. 1. More particularly, FIG. 2 shows the snubber 100 to comprise a plurality of snubber arms 102 which extend radially away from the center of the  
20 snubber 100 and about the circumference of the snubber 100. The snubber 100 is secured to the base deck 12 by way of a suitable fastener 104, which as shown in FIG. 2 is provided with a threaded portion 106 which engages with a threaded hole

108 of the base deck 12.

The snubber arms 102 are configured to extend a nominal distance within the radial extent of the discs 18, as shown. Particularly, the snubber arms 102 are configured to extend sufficiently into the stack of discs 18 to constrain vertical  
5 deflection of the discs 18 as a result of mechanical shock. However, the snubber arms 102 preferably do not extend to the recording surfaces (not shown) of the discs 18, as damage to the surfaces of the discs 18 may occur at locations where the discs 18 contact the snubber arms 102 during deflection of the discs 18. Thus, the distance the snubber arms 102 extend into the stack of discs 18 is an important consideration  
10 and will be dependent upon the design of a particular disc drive.

Additionally, the snubber arms 102 are vertically dimensioned to fit between the discs 18 as shown. It is expressly contemplated that the vertical dimensions of the snubber arms 102 will be less than the vertical dimensions of the gaps between adjacent discs 18, but will be greater than the vertical dimensions of the actuator arms  
15 24 (of FIG. 1), to prevent contact between the discs 18 and the actuator arms 24 during deflection of the discs 18.

The snubber 100 is constructed from a suitable material which will provide the desired mechanical strength to constrain deflection of the discs 18, while at the same time will minimize the potential for damage to the snubber 100 and to the discs 18.  
20 Preferably, the snubber 100 is constructed from a plastic, non-marring material, such as polycarbonate or acetal. As shown in FIG. 1, the snubber 100 is preferably mounted near the E-block 20, in order to maximize protection of the actuator arms 24

and the discs 18. It will be recognized, however, that the snubber 100 can be located at positions other than adjacent to the E-block 20, as desired, further, the use of multiple snubbers 100 at various positions about the circumference of the discs 18 could be found to be advantageous in particular disc drive designs. Additionally, it is contemplated that the snubber arms 102 could extend only about a portion of the circumference of the snubber 100, the portion being adjacent the discs 18.

Referring now to FIG. 3, shown therein is a cross-sectional, elevational view of a generally L-shaped snubber (designated as 100A) having a configuration similar to that of the cylindrical snubber 100 of FIGS. 1 and 2. As with the snubber 100, the snubber 100A of FIG. 3 includes snubber arms 102A which extend radially between adjacent discs 18. Additionally, the snubber 100A is secured to the base deck 12 with a suitable fastener 104A by way of a threaded portion 106A and a corresponding threaded hole 108A in the base deck 12. However, the snubber 100A has an L-shaped, cross-sectional configuration, as shown, including a vertical portion 110A and a horizontal portion 112A, which are configured as desired to provide the necessary strength for the snubber 100A, as well as to conform to internal space requirements of the disc drive 10. It will be recognized that the snubber 100A of FIG. 3 will generally require less space and comprise less material than the snubber 100, which may be important considerations in small form factor or low cost drive designs.

Referring now to FIG. 4, shown therein is a disc drive 10A, which has a configuration similar to the disc drive 10 of FIG. 1 (for purposes of clarity, the same reference numbers for components shown in FIG. 1 have been used in FIG. 4).

However, the disc drive 10A includes a disc shroud 46, which comprises a vertically extending flange adjacent the discs 18. As will be recognized, the disc shroud 46 is typically used to reduce wind resistance from the spinning discs 18 in order to reduce power requirements of the disc drive 10A, an important consideration in low power disc drive applications. Typically, the disc shroud 46 is formed as part of the base deck 12 and extends upwardly therefrom.

Additionally, FIG. 4 shows a snubber (designated as 100B) which is mounted to the disc shroud 46 and to the base deck 12. It will be recognized that the E-block 20 shown in FIG. 4 is at a different rotational position than the E-block 20 shown in FIG. 1 to more fully illustrate the snubber 100B; however, it will be recognized that a portion of the snubber 100B will extend under the E-block 20 when the E-block 20 is positioned as shown in FIG. 1. As with the snubbers 100, 100A discussed hereinabove, the snubber 100B serves to protect the disc drive 10 from damage due to deflection of the discs 18 as a result of mechanical shock.

The snubber 100B is shown in greater detail in FIG. 5, which provides a cross-sectional, elevational view of the snubber 100B in conjunction with the disc shroud 46, the discs 18 and the base deck 12. Particularly, FIG. 5 shows the snubber 100B to include snubber arms 102B, which extend radially between adjacent discs 18, in a manner similar to that described hereinabove. As shown in FIGS. 4 and 5, the snubber 100B is provided with a vertically oriented, C-shaped configuration so that the snubber 100B wraps around the end of the disc shroud 46, as shown, and is secured to the disc shroud 46 by way of a suitable threaded fastener 114.

Additionally, the snubber 100B is secured to the base deck 12 by way of a suitable base deck fastener 104B (by way of threads 106B which engage with a threaded hole 108B in the base deck 12). Thus, the fasteners 104B and 114 secure the snubber 100B relative to the base deck 12 and the disc shroud 46. The vertical height of the fastener 104B and a horizontal portion 116 of the snubber 100B are provided such that mechanical clearance exists between the fastener 104B and the horizontal portion 116 and the E-block 20 (as shown in FIG. 4).

Referring now to FIG. 6, shown therein is an elevational view of an E-block 20A, which is generally similar to the E-block 20 discussed hereinabove, except to the extent that the E-block 20A includes an E-block mounted snubber 100C mounted to the "up-wind" side of the E-block 20. The E-block 20A is shown in conjunction with the discs 18, including the extension of the actuator arms 24 between adjacent discs 18. For purposes of clarity, the load springs 26 and heads 28 have not been shown in FIG. 6, but it will be understood that these elements extend radially from the actuator arms 24; particularly, it will be readily understood by those skilled in the art that the top and bottom actuator arms 24 have one load spring 26 and head 28 extending therefrom, respectively, and the rest of the actuator arms 24 have two load springs 26 and heads 28 extending therefrom, respectively.

The snubber 100C is shown mounted to the side of the E-block 20A, with snubber arms 102C extending adjacent to the corresponding actuator arms 24 between adjacent discs 18. The snubber arms 102C operate in a manner as described hereinabove to protect the actuator arms 24 from damage as a result of deflection of

the discs 18, by limiting the vertical extent of travel of the outer diameters of the discs 18. It will be understood that the snubber 100C is mounted to the side of the E-block 20A by way of a suitable fastener 118, which preferably inserts through a hole (not shown) in the snubber 100C and engages with a corresponding threaded hole (also not shown) in the E-block 20A. It will be recognized by those skilled in the art that in actuator designs that use a screw to secure the bearing cartridge (not separately designated, but surrounding the pivot shaft 22), this screw can also serve as the fastener 118 shown in FIG. 6 to secure the snubber 100C to the E-block 20A.

An important advantage of the snubber 100C is that the protection provided by the snubber arms 102C is generally maximized by the adjacent placement of the snubber arms 102C to the actuator arms 24. Although not shown in the drawings, it will be recognized that the configuration of the snubber arms 102C can be modified as desired to account for the rotary movement of the E-block 20A relative to the discs 18 to minimize the radial extent of the snubber arms 102C into the stack of discs 18 over the range of movement of the E-block 20A.

Referring now to FIG. 7, shown therein, is a top plan view of the E-block 20A and snubber 100C of FIG. 6. For reference, FIG. 7 shows the E-block 20A to be pivotable about the pivot shaft 22, as provided above; additionally, the latching arrangement 32 and the flex circuit assembly 40 of FIGS. 1 and 4 are also shown in FIG. 7, for purposes of clarity.

As shown in FIG. 7, the snubber 100C of FIG. 6 is mounted to the side of the E-block 20A by way the fastener 118. Further, the snubber arms 102C extend as



shown along the actuator arms 24.

Referring now to FIG. 8, shown therein is an elevational view of an E-block 20B, similar in configuration and operation to the E-blocks 20 and 20A discussed hereinabove. The E-block 20B is also shown in conjunction with the discs 18 and includes the actuator arms 24 extending radially between the discs 18, in a manner similar to the E-block 20A of FIG. 6.

However, the E-block 20B of FIG. 8 includes the use of an over-molded snubber 100D, formed using a suitable over-molding process wherein an assembled stack of actuator arms 24 is selectively coated with a layer of material, such as plastic. Particularly, it is contemplated that the E-block 20B of FIG. 7 is subjected to such a process in order to form the over-molded snubber 100D thereon. Particularly, the snubber 100D is similar in configuration to the snubber 100C of FIG. 6, so that snubber arms 102D extend radially between the discs 18 and adjacent to the actuator arms 24; however, instead of providing the snubber arms 102D just adjacent the sides of the actuator arms 24, the over-molded snubber 100D of FIG. 8 includes material along the top and bottom surfaces of the actuator arms 24 as well. Additionally, the over-molding process allows the material comprising the snubber arms 102D to be "curved" with respect to the actuator arms 24, in order to maintain minimum extension of the snubber arms 102D into the stack of discs 18 as the E-block 20B rotates with respect to the discs 18.

The curved characteristic of the snubber arms 102D is more fully illustrated in FIG. 9, which shows a top plan view of the E-block 20B of FIG. 8. It will be

recognized that the curved characteristic of the snubber arms 102D of FIG. 9 facilitates nominally constant extension of the snubber arms 102D into the stack of discs 18, irrespective of the rotary position of the E-block 20B. Further, it will be recognized that, depending upon the rotary position of the E-block 20B with respect to the discs 18 (not shown in FIG. 9), different portions of the snubber arms 102D will extend into the stack of discs 18. Of course, the curved characteristic of the snubber arms 102D can be selected as desired, depending upon the design of a particular drive, including the relative position of the pivot shaft 22 with respect to the discs 18 (and the resulting range of motion of the E-block 20B and the discs 18).

Referring now to FIG. 10, shown therein is a cross-sectional elevational view of a portion of an E-block 20C, which is generally similar to the E-blocks (20, 20A and 20B) described hereinabove, but includes a pin snubber 100E, comprising a plurality of pins 122 extending through each of a plurality of corresponding actuator arms 24A. The actuator arms 24A are generally similar in all respects to the actuator arms 24 described hereinabove, except that the actuator arms 24A are additionally provided with holes 124, through which the pins 122 are inserted during fabrication of the E-block 20C. As shown in FIG. 10, the pins 122 are sized and located accordingly with respect to the outer extreme of the discs 18, so that the pins 122 operate in a fashion as generally described above to limit deflection of the discs 18 as a result of mechanical shocks to the assembly shown therein. The pins 122 are selected from a suitable material that will maximize protection to the E-block 20C and at the same time minimize damage to the discs 18 in the event of a mechanical shock

sufficient to bring the outer extremes of the discs 18 in contact with the pins 122. In one preferred method of fabrication, the holes 124 are drilled through the actuator arms 24A during a single operation, a single pin (not shown) is pressed through all of the holes 124 and the single pin is subsequently machined into the pins 122 configured as shown in FIG. 10.

A top plan view of the E-block 20C of FIG. 10 is shown in FIG. 11, illustrating the relative placement of the pins 122 and the actuator arms 24A. Although the pins 122 have been shown in FIG. 11 to have generally circular shapes, other shapes may be selected as desired, including shapes having a curved characteristic similar to the snubber arms 102D of FIG. 9 to maintain the radial extent of the pins 122 into the stack of discs 18 (not shown in FIG. 11).

Referring now to FIG. 12, shown therein is an elevational view of a portion of an E-block 20D adjacent the stack of discs 18, the E-block 20D including a flex circuit assembly 40A which is generally similar to the flex circuit assembly 40 described hereinabove, with the addition of flex extensions 132 which extend from the flex circuit assembly 40 into the stack of discs 18. More particularly, the flex extensions 132 extend from a PCB 42A of the flex circuit assembly 40A, as shown.

As described hereinabove, electrical signals are transmitted by way of head wires (designated collectively as 134 in FIG. 12) which are routed from the heads 28 (not shown in FIG. 12) and along the actuator arms 24 to the PCB 42A. The distal ends of the head wires 134 are soldered to corresponding pads (collectively "136") on the PCB 42 as shown. The PCB 42 is rigidly mounted to the side of the E-block

20D. The flex extensions 132 extend radially between the discs 18, and are sufficiently rigid to limit deflection of the discs 18, in a manner similar to that described hereinabove. It will be recognized that the advantages associated with the flex circuit assembly 40A of FIG. 12 include the benefit that the snubber features of the flex circuit assembly 40A can be readily incorporated into the design of the flex circuit assembly 40A. Thus, the flex circuit assembly 40A can be implemented into existing drive designs without the need for E-block modifications or additional assembly steps.

Referring now to FIG. 13, shown therein is an elevational view of a portion of an E-block 20E having a flex circuit assembly 40B, which is similar to the flex circuit assembly 40A of FIG. 12, with the exception that the flex circuit assembly 40B includes flex strips 142 which extend along corresponding actuator arms 24B.

The flex strips 142 accommodate connection paths (not shown) from the flex circuit assembly 40B to the heads 28 (not shown in FIG. 13) and serve as alternatives to the head wires 134 of FIG. 12. It will be recognized that the actuator arms 24B include conventional features (not particularly shown) to accommodate the flex strips 142 and such features are generally different from features used to capture and retain the head wires 134 (shown in FIG. 12).

The flex strips 142 of Fig. 13 include tabs 144, which are located near the outer extent of the discs 18. The tabs 144 extend vertically from the flex strips 142 and are configured to limit the deflection of the disc 18, in the manner described hereinabove. As with the flex circuit assembly 40A of FIG. 12, the flex circuit



What is claimed is:

1. A disc drive assembly, comprising:

a base deck;

a spindle motor mounted to the base deck;

a disc mounted to the spindle motor for rotation about a vertical axis, the disc

5 having an inner radius and an outer radius;

an actuator assembly mounted to the base deck adjacent the disc and

controllably rotatable with respect to the disc;

a snubber adjacent the disc, the snubber comprising:

10 a body portion rigidly affixed with respect to the vertical axis of the  
disc; and

snubber arms connected to the body portion, the snubber arms

15 extending from the body portion towards the disc and above and  
below the elevation of the disc, each snubber arm having a distal  
end located at a position adjacent the disc between the inner and  
the outer radii of the disc and towards the outer radius of the  
disc, wherein the heights of the snubber arms limit deflection of  
the disc at the outer radius of the disc as a result of mechanical  
shock forces applied to the disc drive assembly, minimizing  
damage to the disc assembly.

2. The disc drive assembly of claim 1, wherein the snubber is further characterized as cylindrically-shaped, wherein the body portion includes a central hole through which a fastener extends to secure the body portion to the base deck and wherein the snubber arms extend circumferentially about the body portion.

3. The disc drive assembly of claim 1, wherein the snubber is further characterized as L-shaped, wherein the body portion comprises a vertical portion and a horizontal portion, the horizontal portion including a hole through which a fastener extends to secure the body portion to the base deck and wherein the snubber arms  
5 extend from the vertical portion.

4. The disc drive assembly of claim 1, wherein the base deck comprises a disc shroud extending from the base deck proximate to a portion of the outer radius of the disc, and wherein the snubber is mounted to an end of the shroud, the snubber characterized as wrapping around the end of the shroud and comprising fasteners for  
5 fastening the snubber to the shroud and to the base deck.

5. The disc drive assembly of claim 1, wherein the actuator assembly includes actuator arms that extend above and below the disc, and wherein the snubber is integrally formed with the actuator assembly so that the snubber arms are adjacent the actuator arms.

6. The disc assembly of claim 5, wherein the snubber is mounted to the actuator assembly by way of a fastener.

7. The disc drive assembly of claim 5, wherein the snubber is characterized as an over-molded snubber formed from an over-molding process wherein material is deposited upon the actuator arms in selected locations defining the snubber.

8. The disc drive assembly of claim 5, wherein the snubber comprises pins inserted through corresponding holes in the actuator arms.

9. The disc drive assembly of claim 5, further comprising a flex circuit assembly connected to the actuator assembly, and wherein the snubber is characterized as comprising flex extensions adjacent to the actuator arms, the flex extensions extending from the flex circuit assembly.



10. A disc drive assembly, comprising:

a base deck;

a spindle motor mounted to the base deck;

a disc mounted to the spindle motor for rotation about a vertical axis, the disc

5 having an inner radius and an outer radius;

a snubber adjacent the disc, the snubber comprising:

a body portion mounted to the base deck; and

snubber arms connected to the body portion, the snubber arms

10 extending from the body portion towards the disc and above and  
below the elevation of the disc, each snubber arm having a distal  
end located at a position adjacent the disc between the inner and  
the outer radii of the disc and towards the outer radius of the  
disc, wherein the heights of the snubber arms limit deflection of  
the disc at the outer radius of the disc as a result of mechanical  
15 shock forces supplied to the disc drive assembly.

11. The disc drive assembly of claim 10, wherein the snubber is further  
characterized as cylindrically-shaped, wherein the body portion includes a central hole  
through which a fastener extends to secure the body portion to the base deck and  
wherein the snubber arms extend circumferentially about at least a portion of the body  
5 portion.



13. A disc drive assembly, comprising:

a base deck;

a spindle motor mounted to the base deck;

a disc mounted to the spindle motor for rotation about a vertical axis, the disc

5 having an inner radius and an outer radius;

an actuator assembly mounted to the base deck adjacent the disc and

controllably rotatable with respect to the disc, the actuator assembly  
including:

actuator arms extending radially towards the disc and located above and

10 below the disc;

limiting means, adjacent the actuator arms, for limiting the vertical

deflection of the disc from a mechanical shock to the disc drive,

the limiting means extending above and below the elevation of

the disc between the inner and the outer radii of the disc and

15 towards the outer radius of the disc, the limiting means having a

vertical dimension greater than the vertical dimension of the

actuator arms.

14. The disc drive assembly of claim 13, wherein the limiting means is  
mounted to the actuator assembly by way of a fastener.

15. ~~The disc drive assembly of claim 13,~~ wherein the limiting means is

formed from a process comprising the steps of depositing material over the actuator arms.

16. The disc drive assembly of claim 13, wherein the limiting means comprises pins inserted through corresponding holes in the actuator arms.

17. The disc drive assembly of claim 13, further comprising a flex circuit assembly connected to the actuator assembly, and wherein the limiting means is characterized as comprising flex extensions adjacent to the actuator arms, the flex extensions extending from the flex circuit assembly.

### Abstract of the Disclosure

Apparatus for protecting a disc drive from damage due to non-operational mechanical shocks, the disc drive comprising a rotatable disc having an inner radius and an outer radius and a controllably rotatable actuator adjacent the disc. A snubber is provided adjacent the disc, the snubber having a body portion rigidly affixed with respect to the disc and snubber arms connected to the body portion. The snubber arms extend from the body portion towards the disc and above and below the elevation of the disc, with each snubber arm having a distal end located at a position adjacent the disc between the inner and the outer radii of the disc and towards the outer radius of the disc. The height of each snubber arm limits deflection of the disc at the outer radius of the disc as a result of mechanical shock forced supplied to the disc drive assembly.

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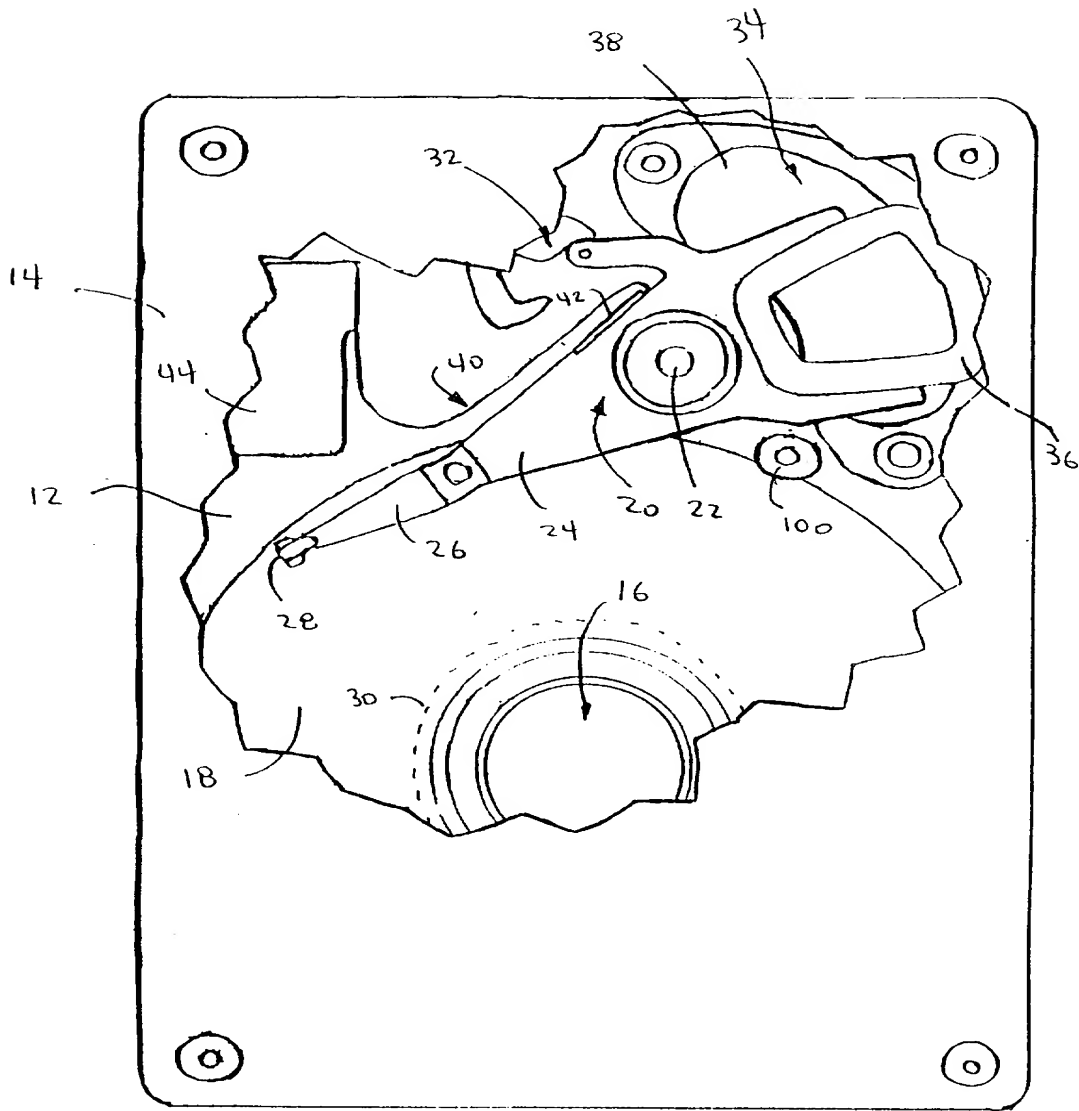


FIG. 1

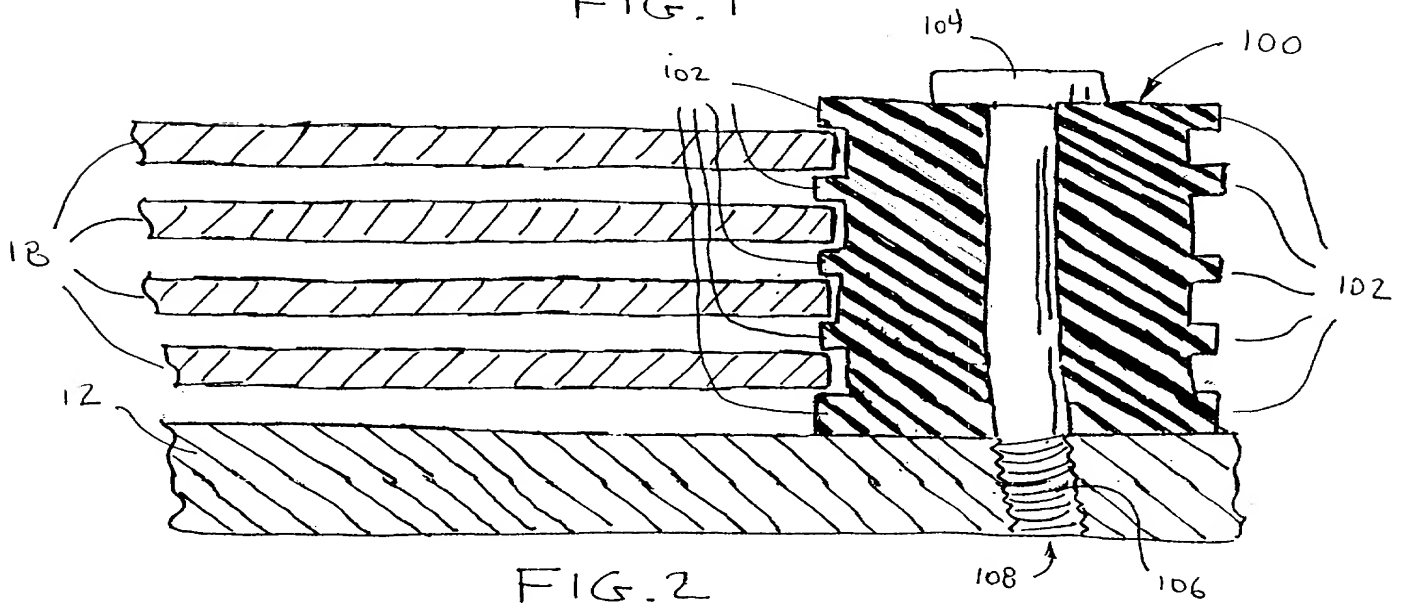


FIG. 2

10A

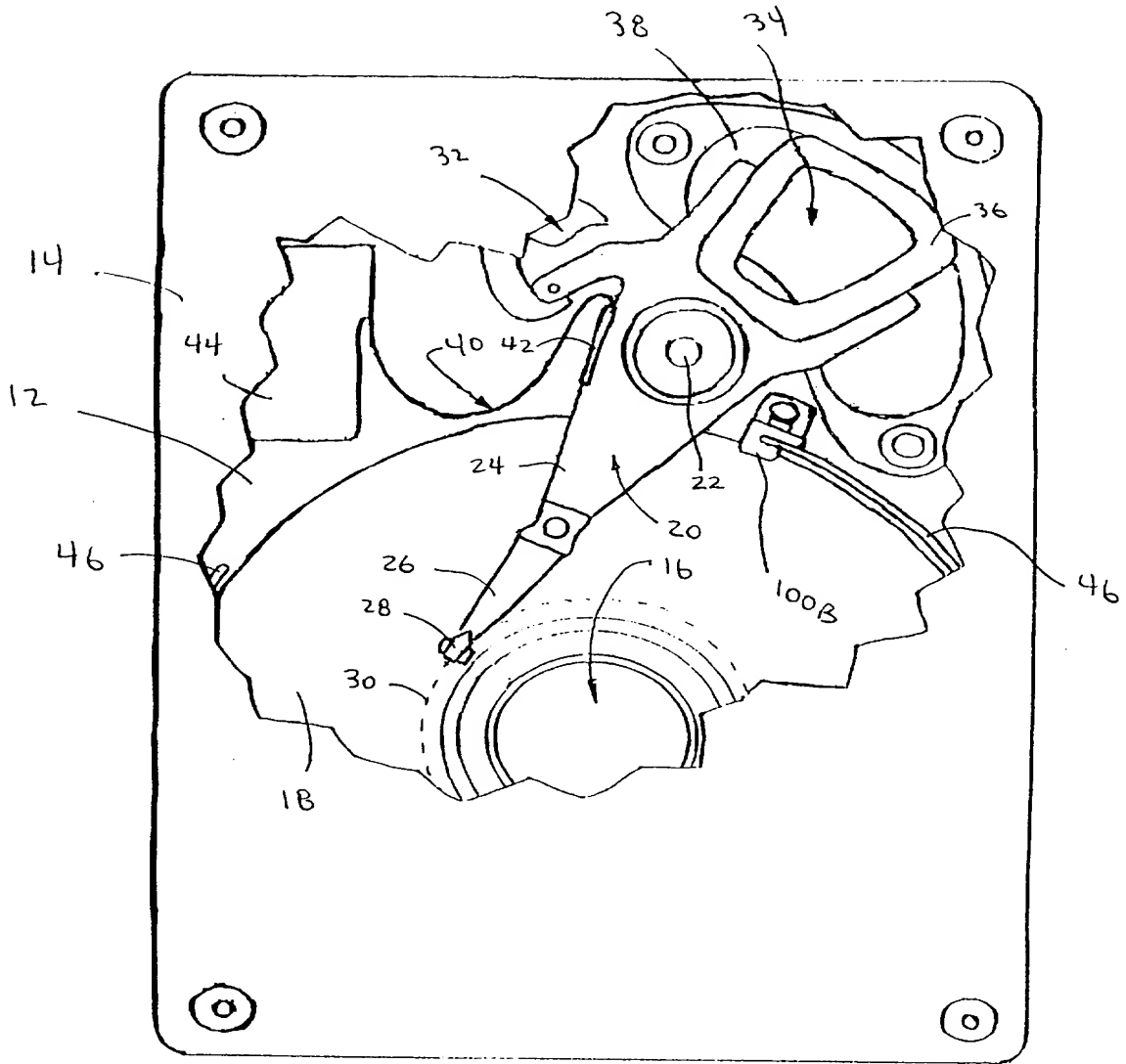


FIG. 4

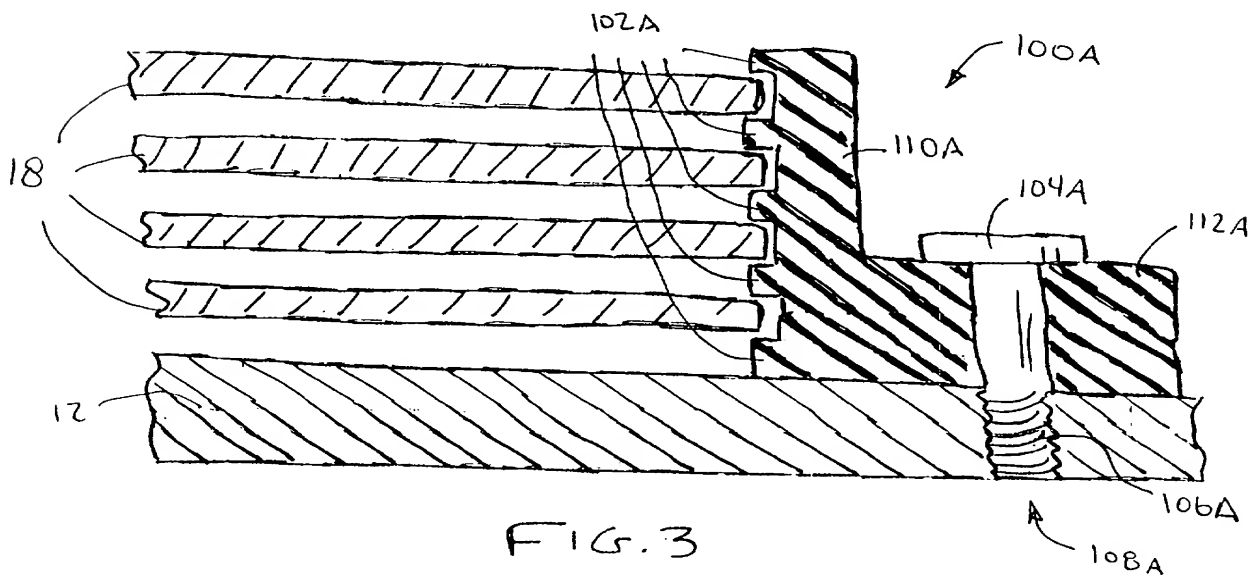
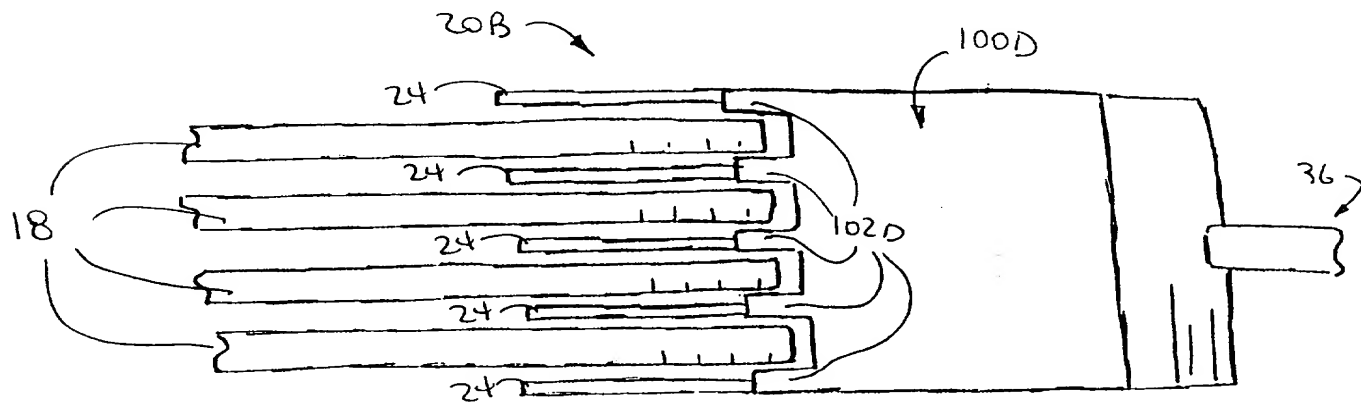
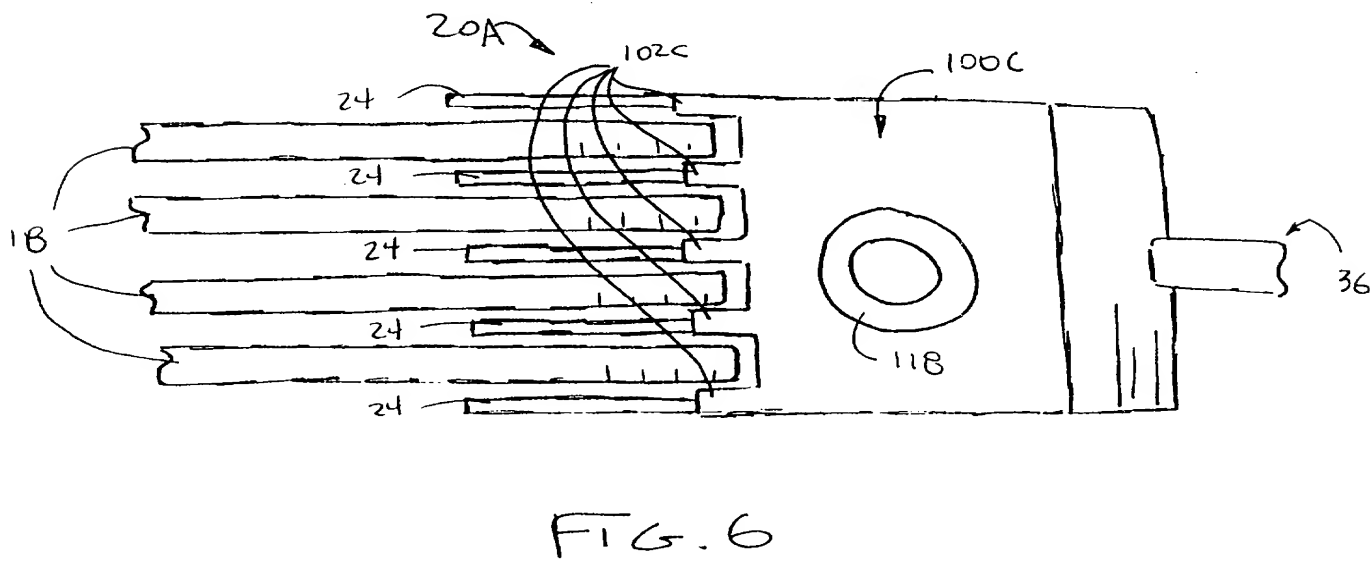
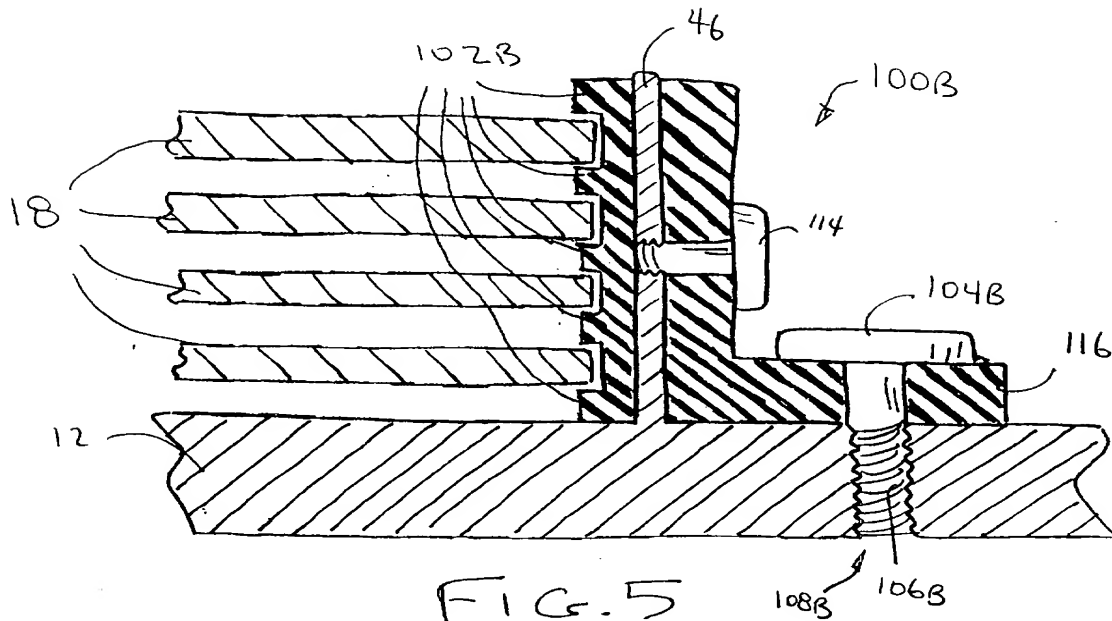
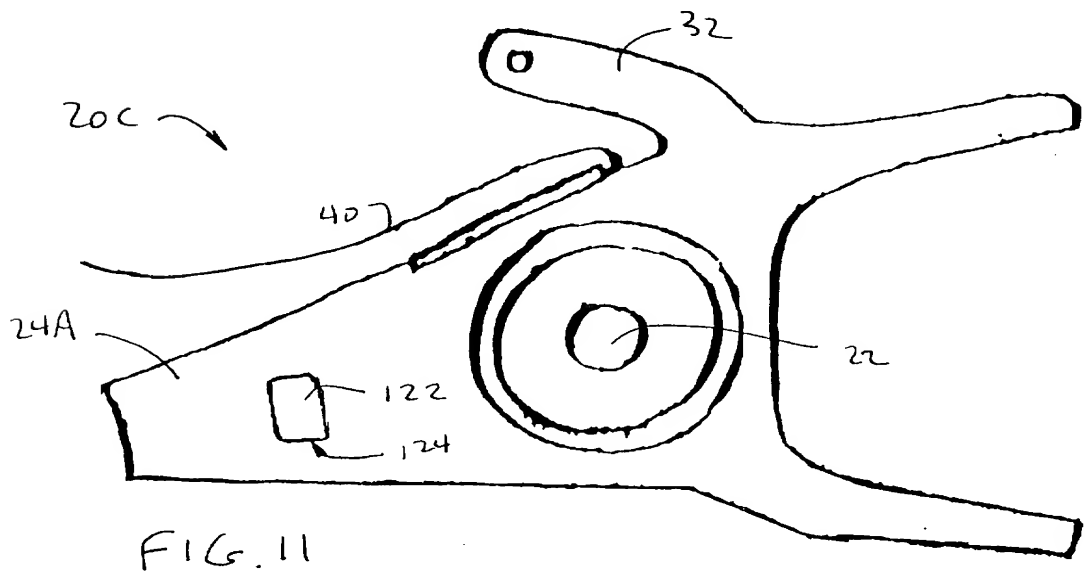
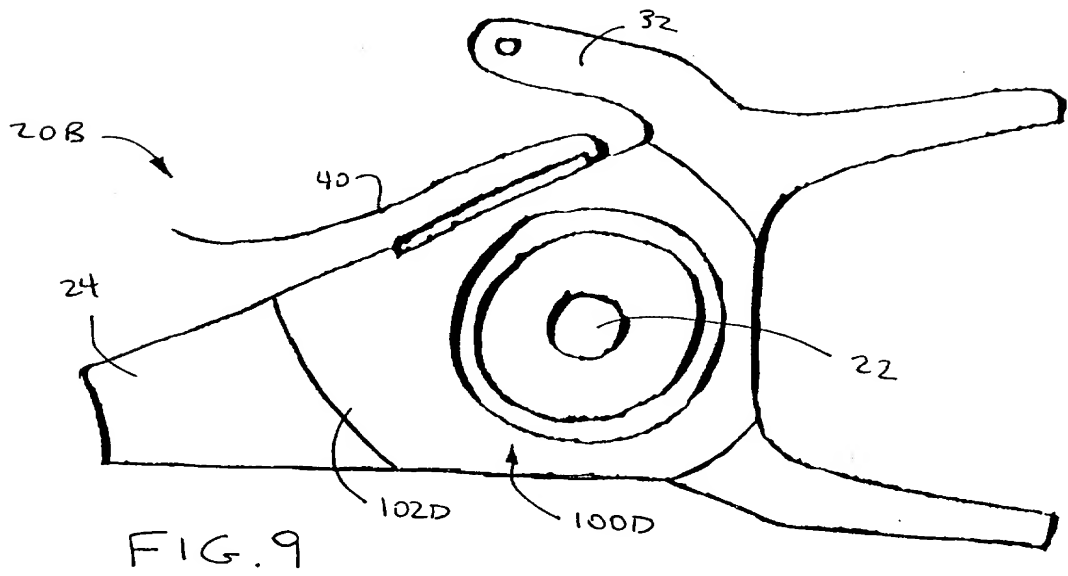
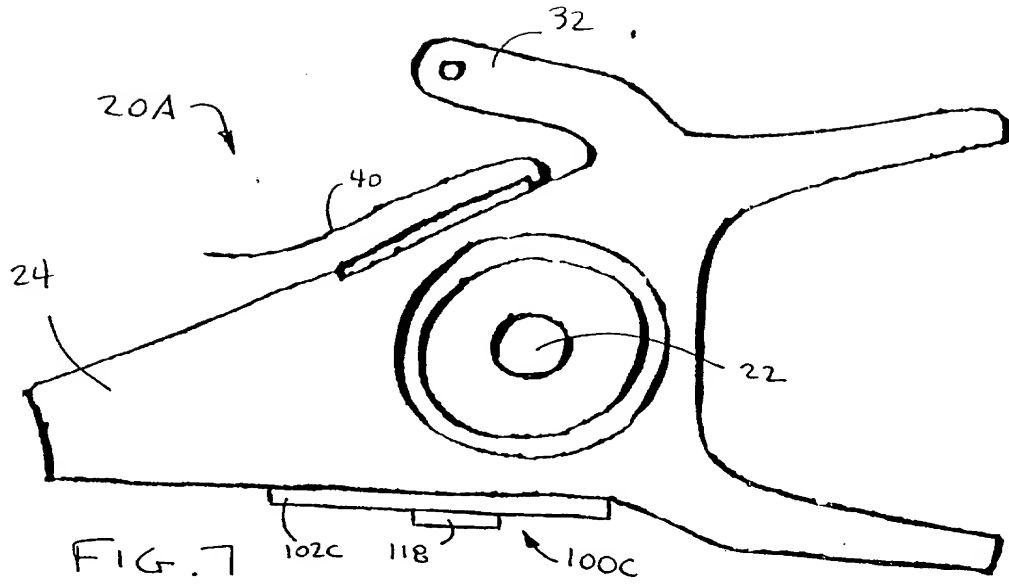


FIG. 3







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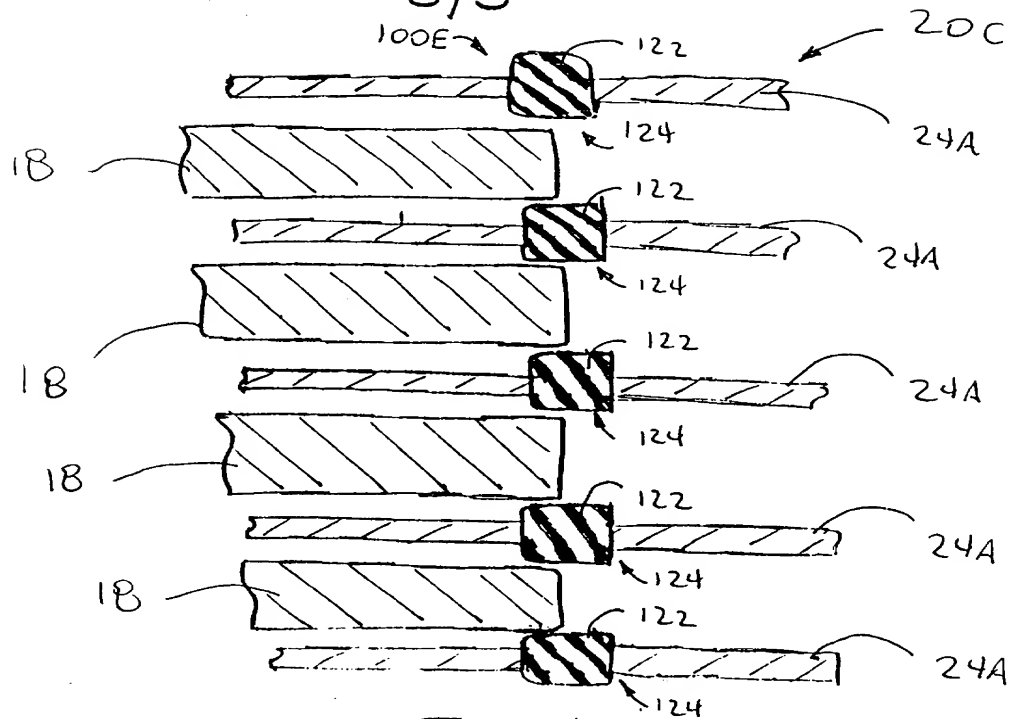


FIG. 10

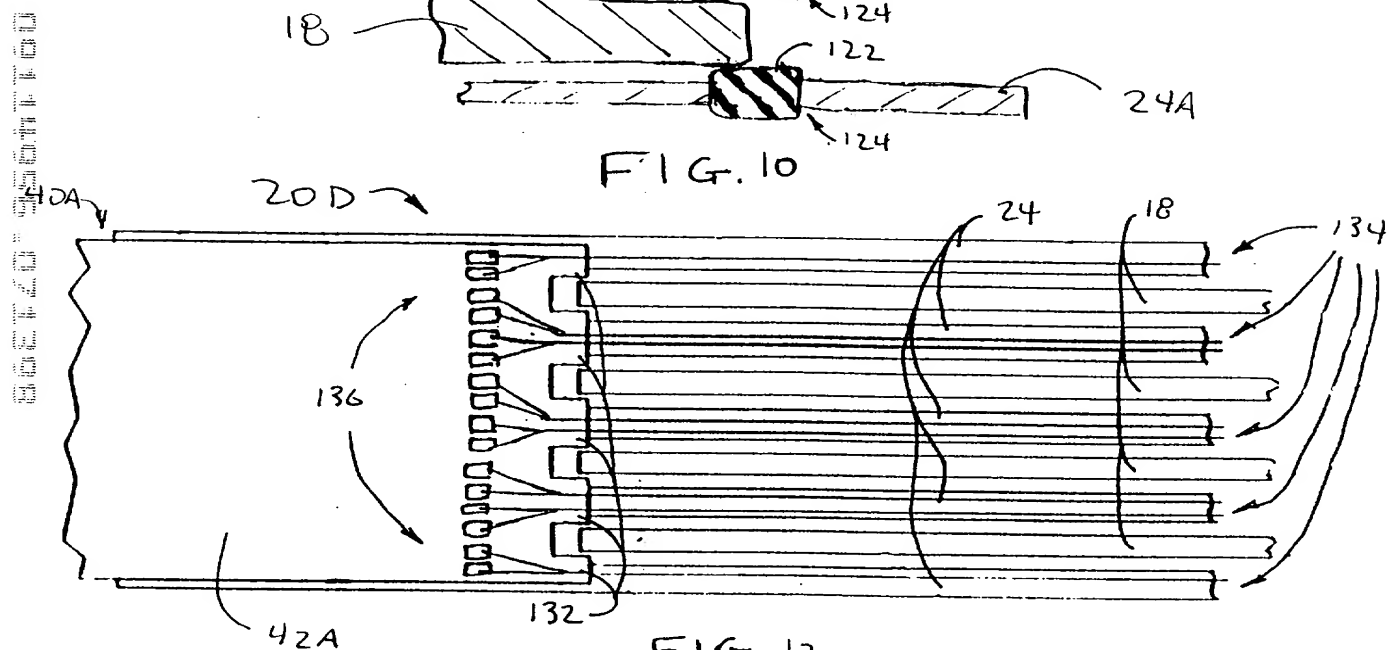


FIG. 12

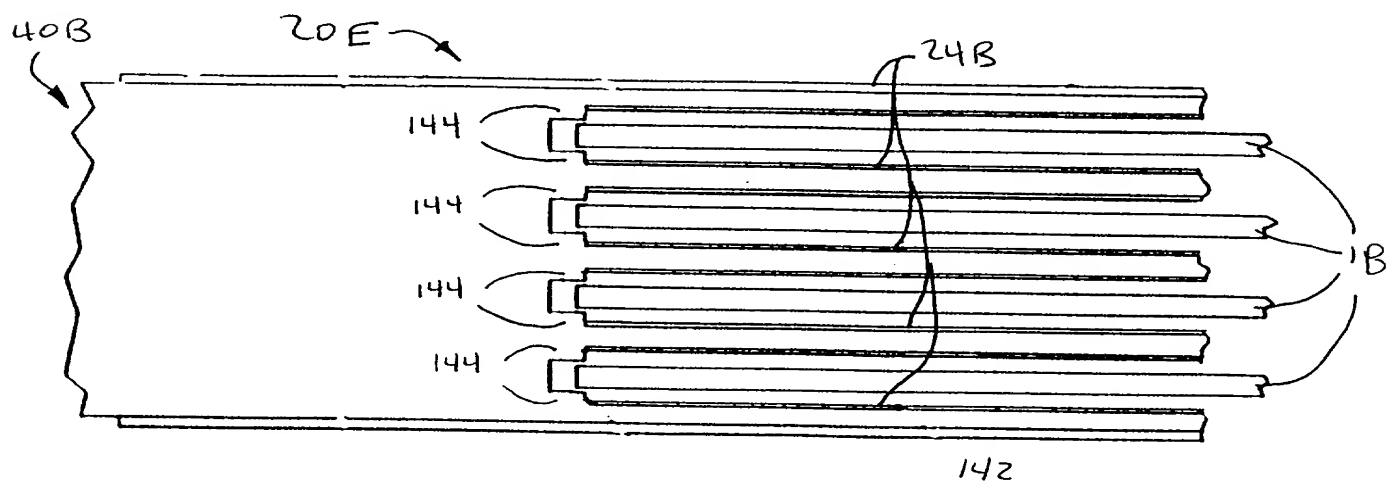


FIG. 13

Attorney's Docket No.

21843

PATENT

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**COMBINED DECLARATION AND POWER OF ATTORNEY**  
**(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL,**  
**DIVISIONAL, CONTINUATION OR C-I-P)**

---

As a below named inventor, I hereby declare that:

**TYPE OF DECLARATION**

This declaration is of the following type:

*(check one applicable item below)*

- ☒ original.
- ☐ design.
- ☐ supplemental.

*NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.*

- ☐ national stage of PCT.

*NOTE: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.*

- ☐ divisional.
- ☐ continuation.
- ☐ continuation-in-part (C-I-P).

## INVENTORSHIP IDENTIFICATION

**WARNING:** *If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.*

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

## TITLE OF INVENTION

MECHANICAL SHOCK PROTECTION FOR A DISC DRIVE

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## SPECIFICATION IDENTIFICATION

the specification of which:

*(complete (a), (b) or (c))*

- (a) ☒ is attached hereto.
- (b) ☐ was filed on \_\_\_\_\_, as ☐ Serial No. \_\_\_\_\_ or ☐ Express Mail No., not yet known \_\_\_\_\_ and was amended on \_\_\_\_\_ *(if applicable)*.

**NOTE:** *Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.*

- (c) ☐ was described and claimed in PCT International Application No. \_\_\_\_\_, filed on \_\_\_\_\_ and as amended under PCT Article 19 on \_\_\_\_\_ *(if any)*.

(Declaration and Power of Attorney [1-1] - Page 2 of 8)

## ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amendment by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56.

*(also check the following items, if desired)*

- ☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and
- ☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

### PRIORITY CLAIM (35 U.S.C. § 119(a)-(d))

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

*(complete (d) or (e))*

- (d) ☐ no such applications have been filed.
- (e) ☐ such applications have been filed as follows.

**NOTE:** *Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.*

**PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN  
12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS  
APPLICATION AND ANY PRIORITY CLAIMS UNDER  
35 U.S.C. § 119(a)-(d)**

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

**CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL  
APPLICATION(S) (34 U.S.C. § 119(e))**

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

**PROVISIONAL APPLICATION NUMBER**

**FILING DATE**

60/004,924

October 6, 1995

60/009,172

December 22, 1995

**CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S)  
UNDER 35 U.S.C. 120**

- ☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART (C-I-P) APPLICATION.

**ALL FOREIGN APPLICATION(S), *IF ANY*, FILED MORE  
THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR  
TO THIS U.S. APPLICATION**

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*NOTE: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.*

**POWER OF ATTORNEY**

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

*(list name and registration number)*

Bill D. McCarthy, Registration No. 26,772  
Edward P. Heller, III, Registration No. 29,075  
Phillip L. Free, Jr., Registration No. 38,143  
Randall K. McCarthy, Registration No. 39,297

*(check the following item, if applicable)*

- ☐ Attached, as part of this declaration and power of attorney, is the authorization

of the above-named attorney(s) to accept and follow instructions from my representative(s).

---

SEND CORRESPONDENCE TO

DIRECT TELEPHONE CALLS TO:  
(Name and telephone number)

Bill D. McCarthy  
McCarthy & Associates, Inc.  
101 Park Avenue - Suite 250  
Oklahoma City, Oklahoma 73102

Bill D. McCarthy  
(405)232-5600

---

### DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

### SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of sole or first inventor

Stephen

R.

Genheimer

(GIVEN NAME)

(MIDDLE INITIAL OR NAME)

FAMILY (OR LAST NAME)

Inventor's signature

*Stephen R. Genheimer*

Date

5-31-76

Country of Citizenship

United States of America

Residence

Mustang, Oklahoma

Post Office Address

1000 E. Whispering Oaks Terrace, Mustang, Oklahoma 73064

■■■■■

(Declaration and Power of Attorney [1-1] - Page 6 of 8)



Full name of second joint inventor, if any

Kenneth

L.

Pottebaum

(GIVEN NAME)

(MIDDLE INITIAL OR NAME)

FAMILY (OR LAST NAME)

Inventor's signature Ken L Pottebaum

Date 5-30-96

Country of Citizenship

United States of America

Residence Yukon, Oklahoma

Post Office Address 321 Red Bud Street, Yukon, Oklahoma 73099



Full name of third inventor, if any

Jon

P.

Baker

(GIVEN NAME)

(MIDDLE INITIAL OR NAME)

FAMILY (OR LAST NAME)

Inventor's signature Jon P. Baker

Date 5/30/96

Country of Citizenship

United States of America

Residence Oklahoma City

Post Office Address 3700 Dow Drive, Oklahoma City, Oklahoma 73115



Full name of fourth inventor, if any

John

D.

Stricklin

(GIVEN NAME)

(MIDDLE INITIAL OR NAME)

FAMILY (OR LAST NAME)

Inventor's signature John D Stricklin

Date 6/2/96

Country of Citizenship

United States of America

Residence Oklahoma City, Oklahoma

Post Office Address 1109 Lakeridge Run, Oklahoma City, Oklahoma 73170

(Declaration and Power of Attorney [1-1] - Page 7 of 8)

*(check proper box(es) for any of the following added page(s)  
that form a part of this declaration)*

- ☐ Signature for fourth and subsequent joint inventors. Number of pages added \_\_\_\_.

\*\*\*

- ☐ Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added \_\_\_\_.

\*\*\*

- ☐ Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. Number of pages added \_\_\_\_.

\*\*\*

- ☐ Added page for signature by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47)

\*\*\*

- ☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application. Number of pages added \_\_\_\_.

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- ☐ Authorization of attorney(s) to accept and follow instructions from representative.

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*(if no further pages form a part of this Declaration  
then end this Declaration with this page and check the following item)*

- ☒ This declaration ends with this page.

**EXPRESS MAIL RECEIPT NO.: EL097004215US**  
**DEPOSITED ON July 13, 1998**

**DKT. 22306**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

<b>Applicants:</b>	<b>Stephen R. Genheimer</b>	)	<b>Group Art: Unknown</b>
	<b>Kenneth L. Pottebaum</b>	)	
	<b>Jon P. Baker and</b>	)	<b>Examiner: Unknown</b>
	<b>John D. Stricklin</b>	)	
		)	<b>PRELIMINARY</b>
<b>Application No.:</b>	<b>Not yet assigned</b>	)	<b>AMENDMENT</b>
		)	
<b>Filed:</b>	<b>July 13, 1998</b>	)	
		)	
<b>For:</b>	<b>ACTUATOR ASSEMBLY</b>	)	
	<b>MOUNTED DISC SNUBBER</b>	)	<b>Date: July 13, 1998</b>

**PRELIMINARY AMENDMENT**

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Assistant Commissioner for Patents  
Washington D.C. 20034

Dear Sir:

Please enter the following preliminary amendments in the above identified  
divisional United States patent application.

**In the Title:**

Please change the title of the application to

**- -ACTUATOR ASSEMBLY MOUNTED DISC SNUBBER- -.**

**In the Claims:**

Please cancel claim 1.

Please add the following new claims:

18. (New) An actuator assembly for use in a disc drive, comprising:

a rigid actuator body rotatable about a pivot shaft and having a side which extends in a direction substantially parallel to an axis of rotation of a rotatable disc of the disc drive;

a rigid actuator arm which extends from the rigid actuator body to support a read/write head adjacent a surface of the disc; and

a disc snubber affixed to the side of the rigid actuator body comprising a disc snubber arm which extends adjacent a portion of the rigid actuator arm and limits deflection of the disc resulting from application of a non-operational shock to the disc drive to minimize contact between the disc and the rigid actuator arm.

19. (New) The actuator assembly of claim 18, wherein the read/write head is operably configured to rest upon the disc surface at a landing zone defined at an inner radius of the disc and wherein a distance the disc snubber arm extends adjacent the rigid actuator arm is selected so that the disc snubber arm is disposable over the disc surface

5 at such time that the head is brought to rest upon the landing zone and is retracted  
beyond an outer radius of the disc at such time that the read/write head is moved to a  
position over the disc surface between the inner and outer radii of the disc.

20. (New) The actuator assembly of claim 18, further comprising a fastener  
which extends through the disc snubber and into the side of the rigid actuator body to  
affix the disc snubber to the rigid actuator body.

21. (New) A disc drive, comprising:

a disc rotatable about a disc axis and having a surface on which data are

magnetically stored; and

an actuator assembly mounted for rotation adjacent the disc, comprising:

5 a rigid actuator body rotatable about a pivot shaft and having a side which

extends in a direction substantially parallel to the disc axis;

a rigid actuator arm which extends from the rigid actuator body over the

disc surface to support a read/write head adjacent the disc surface;

and

10 a disc snubber affixed to the side of the rigid actuator body comprising a

disc snubber arm which extends adjacent a portion of the rigid

actuator arm and limits deflection of the disc resulting from

application of a non-operational shock to the disc drive to

minimize contact between the disc and the rigid actuator arm.

22. (New) The disc drive of claim 21, wherein the read/write head is brought to

rest upon the disc surface at a landing zone defined at an inner radius of the disc and

wherein a distance the disc snubber arm extends adjacent the rigid actuator arm is

selected so that the disc snubber arm is disposable over the disc surface at such time that

5 the head is brought to rest upon the landing zone and is retracted beyond an outer radius

of the disc at such time that the read/write head is moved to a position over the disc

surface between the inner and outer radii of the disc.

23. (New) The disc drive of claim 21, further comprising a fastener which extends through the disc snubber and into the side of the rigid actuator body to affix the disc snubber to the rigid actuator body.

24. (New) A disc drive, comprising:

a rotatable disc; and

limit means for limiting deflection of the disc in response to application of a non-operational shock to the disc drive.



**In the Drawings:**

Please amend FIG. 13 to add lead lines for reference numeral "142" as shown in the accompanying red-lined drawing.

**In the Specification:**

Page 1: line 2, delete "priority to" and substitute - -the benefit of- - therefor;  
lines 3-4, delete "and Provisional Application Serial No. 60/009,172 filed December 22, 1995, which are also"; and  
line 17, delete "extends" and substitute - -extend- - therefor.

Page 4: line 1, after "rotary actuator" insert - -is- -.

Page 9: line 14, delete "grater" and substitute - -greater- - therefor.

Page 16: line 22, delete both occurrences of "42" and substitute - -42A- - therefor.

**Remarks**

The present application is a divisional of parent United States Patent Application No. 08/659,338 filed June 6, 1996 (hereinafter "parent application"). During prosecution, the parent application was subjected to a restriction requirement in an Office Action mailed February 13, 1997. Thus, the present divisional application has been directed to

non-elected subject matter in the parent application, namely, Species IV, FIGS. 6-7, drawn to an actuator assembly mounted disc snubber.

This Preliminary Amendment presents certain amendments to the title, claims, drawings and specification of the present divisional application.

The title of the present divisional application has been changed from "MECHANICAL SHOCK PROTECTION IN A DISC DRIVE" to "ACTUATOR ASSEMBLY MOUNTED DISC SNUBBER" to more particularly identify the claimed subject matter.

With regard to the claims, claims 2-17 have been canceled by the accompanying transmittal letter, claim 1 has been canceled hereinabove, and new claims 18-24 have been added. The newly added claims are generally directed to a disc drive of the type having at least one rotatable disc and a rotary actuator assembly adjacent the disc, the actuator assembly having a side to which a disc snubber is attached. The snubber includes a snubber arm that extends over a portion of the disc and limits deflection of the disc resulting from application of a non-operational shock to the disc drive. As discussed during the prosecution of the parent application, severe contact between a rigid disc and a rigid actuator arm can directly damage the disc and/or the actuator arm, and can also damage a read/write head supported by the arm due to the propagation of wave energy down the actuator arm, resulting in the head lifting up and slapping down against the disc. This damage is minimized through the use of the snubber recited in the claims.

With regard to the drawings, a minor error of a typographical nature was discovered during prosecution of the parent application, in that FIG. 13 did not include lead lines from reference numeral "142" to point out the flex strips illustrated therein. Accordingly, these lead lines have been provided in the accompanying red-lined drawing.

With regard to the specification, several minor errors of a typographical nature were identified during prosecution of the parent application. The amendments to the specification presented above have been provided to correct these errors.

The Applicants submit that these amendments to the title, claims, drawings and specification are proper, do not introduce new matter and place the present divisional application in proper condition for examination.

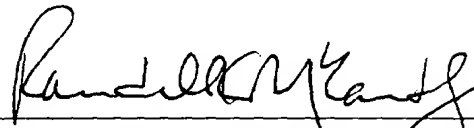
With the entering of these amendments, the status of the claims in the present divisional application is as follows:

<u>Claim</u>	<u>Status</u>
18. (New)	Independent.
19. (New)	Depends from claim 18.
20. (New)	Depends from claim 18.
21. (New)	Independent.
22. (New)	Depends from claim 21.
23. (New)	Depends from claim 21.
24. (New)	Independent.

The Applicants accordingly request that the Examiner examine the present divisional application and pass the same to issuance. The Examiner is invited to contact the Applicants Attorney should any questions arise concerning this amendment.

Respectfully submitted,

**STEPHEN R. GENHEIMER,  
KENNETH L. POTTEBAUM  
JON P. BAKER and  
JOHN D. STRICKLIN  
Applicants**

By:   
Bill D. McCarthy, Registration No. 26,772  
Randall K. McCarthy, Registration No. 39,297  
Crowe & Dunlevy  
101 Park Avenue - Suite 250  
Oklahoma City, Oklahoma 73102  
Telephone: (405) 232-5600  
Facsimile: (405) 232-5635